

What is Claimed is:

1. A time-of-flight mass spectrometer comprising:
 - a) ion flight path means defining a flight path for ions and having an ion entrance and an ion exit comprising:
 - i) at least one field free region;
 - ii) at least one electric sector, each electric sector having an entry and an outlet; and
 - iii) at least one ion optical element associated with at least one electric sector, wherein each ion optical element modifies the potential experienced by an ion entering or exiting an electric sector;
 - b) an ion source including means for accelerating a pulse of ions from the ion source into the ion entrance of the ion flight path means;
 - c) an ion detector in communication with the ion exit of the ion flight path means; and
 - d) means for recording a time-of flight spectrum of the detected ions.
2. The mass spectrometer of claim 1 wherein the ion optical element comprises an Einzel lens.
3. The mass spectrometer of claim 1 wherein the ion optical element comprises at least one adjustable trim electrode that adjustably modifies the potential experienced by an ion entering or exiting an electric sector.

4. The mass spectrometer of claim 1 or claim 2 wherein the ion source is a laser desorption ion source.

5. The mass spectrometer of claim 1 or claim 2 wherein the ion source includes means for selectively providing one or more masses or ranges of masses.

6. The mass spectrometer of claim 5 wherein the ion source further includes means for providing fragments of the selected masses or ranges of masses.

7. The mass spectrometer of claim 3 wherein the adjustable trim electrode is disposed between the entry and the outlet of the electric sector.

8. The mass spectrometer of claim 3 wherein the at least one adjustable trim electrode comprises a pair of adjustable trim electrodes disposed so that the ions pass between the adjustable trim electrodes of the pair, wherein the pair is associated either with an entry or an outlet of an electric sector.

9. The mass spectrometer of claim 3 wherein the at least one adjustable trim electrode comprises a plurality of pairs of adjustable trim electrodes, each pair disposed so that the ions pass between the adjustable trim electrodes of the pair, wherein a pair is associated with each entry and each outlet of each electric sector.

10. The mass spectrometer of claim 9 comprising four electric sectors, each electric sector having a deflection angle of about 270 degrees, wherein a field free region separates each electric sector.

11. The mass spectrometer of claim 3 comprising a plurality of electric sectors, wherein the at least one adjustable trim electrode comprises a first and second pair of adjustable trim electrodes, each pair disposed so that the ions pass between the adjustable trim electrodes of the pair, wherein the first pair is associated with the entry of the electric sector closest to the entrance of the ion flight path and the second pair is associated with the outlet of the electric sector closest to the exit of the ion flight path.

12. The mass spectrometer of claim 11 comprising four electric sectors, each electric sector having a deflection angle of about 270 degrees, wherein a field free region separates each electric sector.

13. The mass spectrometer of claim 3 wherein the ion source includes laser desorption/ionization means.

14. The mass spectrometer of claim 3 wherein the ion source includes chemical ionization means, electron impact ionization means, photoionization means or electrospray ionization means.

15. The mass spectrometer of claim 3 wherein the ion source includes means for selectively providing ions of one or more masses or ranges of masses.
16. The mass spectrometer of claim 3 wherein the ion source comprises a quadrupole ion trap.
17. The mass spectrometer of claim 3 wherein the ion source comprises means to extract a group of ions from a pulsed or continuous ion beam in a direction substantially perpendicular to the direction of the beam.
18. The mass spectrometer of claim 3 wherein the means for accelerating a pulse of ions comprises a voltage pulse applied subsequent to formation of the ions.
19. The mass spectrometer of claim 15 wherein the means for selectively providing ions comprises a quadrupole ion trap or a linear ion trap.
20. The mass spectrometer of claim 15 wherein the ion source further includes means for providing fragments of the selected masses or ranges of masses.
21. The mass spectrometer of claim 16 wherein the ion flight path means further comprises a field free region before the first electric sector and after the last electric sector.

22. The mass spectrometer of claim 12 wherein the ion flight path means further comprises a field free region before the first electric sector and after the last electric sector.

23. The mass spectrometer of claim 19 wherein the ion source is a laser desorption ion source.

24. The mass spectrometer of claim 3 further comprising at least one Herzog shunt having an aperture, wherein each Herzog shunt is associated with either the entry or the outlet of an electric sector such that the ions pass through the aperture.

25. The mass spectrometer of claim 3 further comprising an enclosure, wherein the enclosure is configured to enclose at least one electric sector.

26. The mass spectrometer of claim 25 wherein the enclosure includes at least one aperture, wherein at least one aperture is configured as a Herzog shunt.

27. The mass spectrometer of claim 3 further comprising a control system configured to adjust the trim electrodes, wherein the adjustment adjustably modifies the potential experienced by an ion entering or exiting an electric sector.

28. The mass spectrometer of claim 27 wherein the control system comprises a software program.

29. A method for tuning a time-of-flight mass spectrometer comprising:
- a) providing a mass spectrometer of claim 1 or claim 3;
 - b) determining the resolution or sensitivity of detection of ions at a first setting by:
 - i) applying a potential to at least one adjustable trim electrode;
 - ii) obtaining a first mass spectrum of ions from the ion source; and
 - iii) determining resolution or sensitivity of detection from the first mass spectrum;
 - c) determining the resolution or sensitivity of detection of ions at a second setting by:
 - i) adjusting the potential applied to at least one adjustable trim electrode;
 - ii) obtaining a second mass spectrum of ions from the ion source; and
 - iii) determining resolution or sensitivity of detection from the second mass spectrum; and
 - d) determining whether resolution or sensitivity of detection of ions is improved or degraded at the second setting.

30. The method of claim 29 further comprising, if resolution is determined to be degraded at the second setting:

e) determining the resolution or sensitivity of detection of ions at a third setting by:

i) adjusting the potential applied to at least one adjustable trim electrode in a direction opposite to the adjustment of the second setting;

ii) obtaining a third mass spectrum of ions from the ion source; and

iii) determining resolution or sensitivity of detection from the third mass spectrum; and

f) determining whether resolution or sensitivity of detection of ions is improved or degraded at the third setting.

31. The method of claim 29 further comprising, if resolution is determined to be improved at the second setting:

e) determining the resolution or sensitivity of detection of ions at a third setting by:

i) adjusting the potential applied to at least one adjustable electrode in a direction the same as the adjustment of the second setting;

ii) obtaining a third mass spectrum of ions from the ion source; and

iii) determining resolution or sensitivity of detection from the third mass spectrum; and

f) determining whether resolution or sensitivity of detection of ions is improved or degraded at the third setting.